

CRASHWORTHINESS RESEARCH NEWS

Volume 1, Number 2

July 1996

NHTSA/OCR Biomechanics Division Unveils New Advanced Frontal Crash Test Dummy at 15th ESV Conference

The Biomechanics Division and the Advanced Frontal Dummy Development Program met a key scheduled milestone in May, 1996, with the delivery of two fully integrated mid-sized male advanced dummy prototypes, and their display before an international audience at the 15th ESV conference in Melbourne, Australia.

The new prototypes embody improved design and injury assessment features in nearly every body region, as compared to existing dummy technology. The new design offers:

- * more human like thoracic structure with multiple high-speed 3D deflection instrumentation;
- * an articulating spine with new adjustable vehicle-seated posture;
- * an improved shoulder design with more human like mobility;
- * a new abdomen design featuring upper and lower modules, with continuous 3D deflection measurement;
- * a new pelvis design with revised flesh segmentation, new hip joints with injury assessment capability, and submarining detection features;
- * a new compliant femur design for more realistic femur loads;
- * a new, simplified load-sensing face;
- * a new neck with more human like frontal flexion, extension, lateral flexion, and axial compression characteristics;

- * an advanced lower extremity (ALEX) design with more human like ankle/foot motions and expanded injury assessment capability; and
- * overall design for ease of certification, maintenance, and use.

The new dummy represents the synthesis of the efforts of a large number of organizations and individuals on an international basis. The prime contractor for the effort was GESAC, Inc., of Kearneysville, WVA (N. Rangarajan, President). Key contributors within NHTSA were Mark Haffner (Advanced Frontal Dummy Program Manager), Rolf Eppinger (Chief, Biomechanics Division), and Howard Pritz of the Vehicle Research and Test Center. Other major contributors to the program were Transport Canada, the SAE Frontal Dummy Enhancement Task Force (Roger Daniel, Chair), the Occupant Safety Research Partnership (USCAR), the European Experimental Vehicles Committee Working Group 12, the Japan Automobile Research Institute, the Japanese Automobile Manufacturers' Association, and other research laboratories and individual vehicle manufacturers.

Following a planned period of internal test and evaluation, refined advanced dummy prototypes will be leased by NHTSA in January 1997 for evaluation by interested automotive manufacturers, suppliers, and test laboratories worldwide. International harmonization of the advanced dummy product remains as a significant goal of the dummy program, and is thus being actively pursued. During the latter half of 1997, the dummy and associated documentation will be further refined and made available for general manufacture and use. Initial applications of the new dummy are expected to be in the research and vehicle development environment.

Further work is now being planned within the Biomechanics Division to adapt the new dummy technology to small female and large male sizes. In addition, significant effort is underway to advance the state of the art in dummy-based instrumentation. New techniques for sensing of dynamic thorax deflection are under development, as are techniques for sensing and resolving loads delivered into the dummy hip joint (which relate to serious hip fractures seen in the field). Also being actively pursued is a technique for dynamic measurement of dummy spinal curvature, which will find application to spinal injury assessment and to overall assessment of occupant restraint performance.

15th International Technical Conference on the Enhanced Safety of Vehicles

Ralph Hitchcock and Rolf Eppinger represented the Office of Crashworthiness Research at the 15th International Technical Conference on the Enhanced Safety of Vehicles held in Melbourne, Australia. Also in Australia were Tom Hollowell, Office of Crashworthiness Research, and Mike Monk, Vehicle Research and Test Center, who were representing their respective offices for a series of meetings with Australia's New Car Assessment (NCAP) Group.

Ralph Hitchcock chaired ESV Technical Session 4, Vehicle Aggressivity and Compatibility for Occupant Protection, due to a last minute personal emergency of the scheduled Chairperson, Bernd Friedel of Germany. Tom Hollowell and Mike Monk presented a number of papers

written by their respective staffs. Dr. Hollowell presented papers authored by his Division on "NHTSA's Improved Frontal Protection Research Program," authored by Lee Stucki and Tom Hollowell; on "NHTSA's Vehicle Aggressivity and Compatibility Research Program," by Tom Hollowell and Clay Gabler; and on "Opportunities to Improve First Generation Air Bags," by Jerry Kossar. Mike Monk presented papers on "Current Research in Rollover and Occupant Retention," authored by Steve Summers, Glen Rains, and Don Willke; on "Concepts to Reduce Heavy Truck Aggressivity in Truck-to-Car Collisions," by Bob Clarke, Don Willke, and others; and on "Evaluation of Aftermarket Devices to Reposition Shoulder Belts," by Lisa Sullivan and others.

In addition to these papers, Dr. Hollowell's Division also authored papers on "The Use of Advanced Analytical Techniques in Side Impact Crashworthiness Research," authored by Randa Radwan Samaha and others; on "Improved Occupant Protection Through Advanced Seat Design," by Jerry Kossar and others; and on "An Upgraded System for Crash Test Data Acquisition System Evaluation," by Randa Radwan Samaha and others.

HARMONIZATION

A significant outcome of the conference was the agreement for international harmonization. Representatives from nine countries and two organizations, the EC and EEVC met prior to the opening of the conference. During this meeting, agreement was reached on a U.S. initiative to establish an International Harmonized Research Agenda. Six research priorities were agreed to, and lead countries for each were identified:

- * Biomechanics -- United States
- * Advanced Offset Frontal Crash Protection -- EC/EEVC
- * Pedestrian Safety -- Japan
- * Intelligent Transportation Systems -- Canada
- * Vehicle Compatibility -- EC/EEVC
- * Development of a Scientific Model to Determine Functional Equivalency of Existing Regulations -- United States in cooperation with Australia

All participating countries will participate in the research for the six priorities. It was further agreed that the automotive industry should play an active role in the research process. NHTSA will use the Motor Vehicle Research Advisory Committee.

NCAP

As part of their visit with the Australian NCAP program members, Tom Hollowell and Mike Monk met the NCAP members in Adelaide, Melbourne, and Sydney. In Adelaide, they visited

Chris Coxon and staff from the South Australian Office of Road Safety. Also attending were Mark Haffner (Biomechanics Division), Bill Walsh (Director of the National Center for Statistics and Analysis), and James Hackney (Director of the Office of Crashworthiness Standards). At this meeting, detailed presentations of ESV papers and the advanced frontal dummy were provided, and detailed discussions pursued regarding both the U.S. and the Australian NCAP programs. Also, while in Adelaide, the group met with Jack McLean of the University of Adelaide's Road Accident Research Unit. Dr. McLean gave an overview of the head injury research being undertaken by his staff. In Sydney, the NHTSA group visited Jack Haley of NRMA Limited, a motoring club in Victoria. At this meeting, the NRMA presented their activities relating to evaluating vehicle damageability in low speed crashes. NRMA's goal in this program is to encourage manufacturers to consider damageability and repairability in the design of their vehicles.

Seventeenth AORCAir Bag/Inflator Recycling/Disposal (ABIRD) Committee Meeting

Jerry Kossar and Lori Summers from the Office of Crashworthiness Research attended the Seventeenth Automobile Occupant Restraint Council (AORC) Air Bag/Inflator Recycling/Disposal (ABIRD) Committee meeting on June 6, 1996 at TRW Vehicle Safety Systems in Washington, Michigan. The majority of the meeting was spent discussing past research activities and future plans by the industry to aid in the prevention of *live* air bags from being shredded upon vehicle disposal. Shredding a live air bag assembly could lead to the emission of toxic chemicals, damaging of shredding equipment, and hazardous working conditions for disposal personnel hand-sorting scrap containing toxic materials.

Since a visual inspection of the air bag module is extremely difficult once the crushed vehicles are delivered from the dismantlers to the shredder facility, electronic tags were investigated as a method of notifying shredder operators whether a live air bag is included in a crushed vehicle shipment. If a live air bag were to be detected, the shredder operator would either return the entire shipment to the dismantler, or levy a fine against the dismantler. Research was carried out by Southwest Research Institute to perform a feasibility study of the application of electronic tagging technology and to conduct laboratory and field testing of the devices.

The research study found that the capability of using electronic tagging on air bag assemblies is technically feasible, however: the cost of manufacturing and installing the electronic tags far exceeds initial considerations, the development of a universal tag (to fit all air bag assemblies) is unlikely, (10M+) vehicles with sodium azide air bag inflators already in the field do not have tags, and an increasing number of "greener" non-azide, pyrotechnic, and compressed gas inflators are projected for future vehicles. Therefore, the results of the feasibility study suggested electronic tagging is not practical at this point in time, and the concept of *training* auto dismantlers in assuring the air bag removal/deployment would be more practical than solving the engineering and monetary challenges that electronic tagging presents.

The committee therefore concluded that the training of dismantlers in air bag removal/disposal would be accomplished through the distribution of an educational video. The audience of the

video would be automotive dismantlers, and the content would contain air bag removal/disposal information such as: safety instruction, handling information, and Automotive Recyclers Association Processing Procedures. A subcommittee was also formed to: reach a consensus on the specific details that are to be included in the video, collect funding for the project, and begin production of the video. The next AORC Recycling/Disposal Committee meeting will be held in October.

Air Bag Systems Task Force Meeting/SAE Inflatable Restraints Subcommittee Meeting

Jerry Kossar and Lori Summers from the Office of Crashworthiness Research and Ed Jettner from Safety Performance Standards attended the Air Bag Systems Task Force meeting and the SAE Inflatable Restraints Subcommittee on May 21, 1996 in Troy, Michigan. The Air Bag Systems Task Force meeting was well attended by a large number of air bag manufacturers and suppliers from industry. The majority of the meeting was spent writing documentation for a new SAE Recommended Practice, J1794 Restraint Systems Effluent Test Procedure. The purpose of this procedure is to collect, identify, and quantify effluent resulting from deployment of in-vehicle stored energy restraint systems. The procedure includes general guidelines for equipment specifications, test procedures, and methods to identify and quantify: 1) particulates (size, concentration, and composition) and 2) gaseous effluents (concentration and composition). This procedure differs from the standard tank test by accounting for effluent dilution effects. Results from this procedure may be used to compare and/or correlate with actual in-vehicle effluent tests

The SAE Inflatable Restraints Subcommittee meeting was likewise well attended. A liaison report was presented from the AORC regarding the production of an instructional film to inform automobile disposal centers (shredders) how to recognize and safely dispose of undeployed air bag systems. Minutes were presented from the last ASTM meeting which discussed the physical testing of air bag fabrics (including permeability tests, and fabric grading). The SAE J1728 Crash Sensor task force was also reactivated and expanded to include interior occupant position sensors and pre-crash sensors. Future task forces were proposed to develop recommended testing/practices for smart air bag systems, air bag noise effects (for multiple deployments), air bag trigger times in low speed sled tests, air bag thermal effects, and recyclable air bag materials. The next meeting will be held in September of 1996.

TAKE YOUR KIDS TO WORK DAY

Office of Crashworthiness Research staff participated in the annual National Celebration of "Take Your Kids To Work Day." Cathy McCullough arranged demonstrations of some of the interesting projects going on in the Office for approximately 30 children of employees of the NHTSA.

Mike Kleinberger in the Biomechanics Division showed them several computer models of the human anatomy. He also showed them full-body models of occupants and full vehicle models. Simulations were shown to demonstrate how an occupant responds during a crash using a variety

of different restraint systems. The children showed great interest in the simulations, but were most impressed by the 23-inch monitor attached to Mike's computer.

Carl Ragland in the Safety Systems Engineering and Analysis Division demonstrated the film analyzer and showed how it was used to analyze motion of the dummies and the vehicle in a crash test. While they may not have been overly impressed with the mechanics of collecting film data, they showed a keen interest in watching the crash test vehicle magically repair itself upon rewinding the film. Others were impressed with the destruction of the vehicle in a crash.

Two graduate students (Rabih Tannous and Ashraf Sherif) working in the Office of Biomechanics Research showed the children how to model human organs for computer simulations. Scale models of the brain and ankle were made available for the children to have a "hands-on" learning experience. The computer program demonstrated the difference injury patterns relative to different impacts.

Upcoming Events:

September 11 Research & Development Programs Public Meeting Holiday Inn (Fair Oaks Shopping Mall) Fairfax, Va.

Contact: Rita Gibbons
(202) 366-4862

September 25 Young People Saving Young People Forum - Jointly Sponsored by Research and Development and Plans and Policy - Room TBA - Nassif

Credits

This is the second issue of an informal newsletter that R&D's Office of Crashworthiness Research plans to publish periodically on their activities.

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